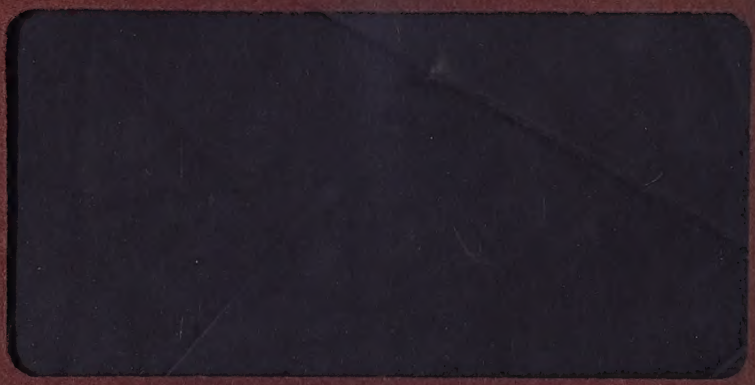
AIRMEC

OPERATING INSTRUCTIONS

WAVE ANALYSER TYPE 248

MP MASTER
MA34333

AIRMEC LIMITED · HIGH WYCOMBE · BUCKS



A I R M E C L I M I T E D

OPERATING INSTRUCTIONS

WAVE ANALYSER TYPE 248

AIRMEC LIMITED,
HIGH WYCOMBE,
BUCKS.

Issue 4

C O N T E N T S

1. INTRODUCTION ... ... page 1

2. SPECIFICATION .. .. page 1

3. DESCRIPTION ... ... page 4
3.1 General ... ... page 4
3.2 Power Supplies ... ... page 4
3.3 H.F. Circuits ... ... page 5
3.4 Two Stage I.F. Amplifier ... ... page 5
3.5 I.F. Attenuators ... ... page 6
3.6 Three Stage I.F. Amplifier and Meter Circuits page 6
3.7 I.F. Output, Meter Protection and F.M. Limiting page 6
3.8 Detector and L.F. Amplifier . ... page 7

4. INITIAL ADJUSTMENT ... ... page 7

5. OPERATION ... ... page 8
5.1 General ... ... page 8
5.2 Operation as a Harmonic Analyser .. page 10
5.3 Operation for Selective Level Measurements ... page 11
5.4 Operation as a Field Strength and Interference Measuring Set . page 11
5.5 Operation for Insertion Gain and Loss Measurements .. page 12
5.6 Operation as a Bridge Detector ... page 12
5.7 Operation as a Heterodyne Wavemeter page 12

6. RACK MOUNTING .. .. page 12

7. SERVICING ... ... page 13
7.1 General ... ... page 13
7.2 Valve Replacements ... ... page 13
7.3 Readjustment of Oscillator .. ... page 13
7.4 I.F. Gain . ... page 14
7.5 Film Scale and Slow Motion Drive .. page 14
7.6 Scale Lamp Replacement ... ... page 14

TABLE 1. Schedule of Components ... ... page 15-21

TABLE 2. Functions of Preset Controls ... page 22

1. INTRODUCTION

The Wave Analyser Type 248 is a selective measuring set suitable for use in the frequency range 5 Mc/s to 300 Mc/s.

It consists essentially of a selective amplifier employing the heterodyne principle and incorporating built-in I.F. attenuators and externally connected H.F. attenuators.

Output indication is provided by means of an average reading meter.

Alternative amplitude or frequency demodulation of the I.F. signal is provided, and the I.F. signal is available for monitoring purposes.

2. SPECIFICATION

Frequency Range: The frequency range is from 5 Mc/s to 300 Mc/s, covered in six bands as follows:-

5 Mc/s to 10 Mc/s
10 Mc/s to 20 Mc/s
20 Mc/s to 40 Mc/s
40 Mc/s to 80 Mc/s
80 Mc/s to 160 Mc/s
160 Mc/s to 300 Mc/s

Frequency Calibration: The frequency calibration is on an illuminated film scale having an effective length of approximately 48 inches.

Frequency Control: The single knob frequency control has a reduction ratio of 90:1 with negligible backlash

Logging Scale: A coarse logging scale from 0 to 45 on the film scale is used in conjunction with an interpolating scale of 100 division fitted to the frequency control knob.

Calibration Accuracy: The accuracy of the scale calibration is within ± 2% on all ranges.

Signal Inputs:	The input level limits are:- 5 microvolts to 15 millivolts r.m.s., increasing to 1.5 volts r.m.s., with the use of the two external H.F. attenuators provided. The above figures refer to an open circuit e.m.f. from a 75 ohms source.
Noise Level:	With an input signal of 5 uV open circuit from a 75 ohms source, and the Wave Analyse set to the 20 kc/s bandwidth position, the effect of noise increases the true meter indication by not more than 3 dB.
Signal Amplitude Calibration:	The signal amplitude calibration is direct reading from the attenuators and meter with the SET GAIN control at maximum. The calibration is in dB's above 5 uV open circuit e.m.f. from a 75 ohm source. The sensitivity of the instrument varies by approximately ± 1.5 dB over the complete frequency range.
Gain Stability:	A 10% change in mains supply voltage produces a change in gain of approximately 1 dB.
Input Impedance:	The nominal input impedance is 75 ohms.
Attenuators:	The range and accuracy of the attenuators are as follows:- I.F. Coarse Attenuator 0 to 60 dB, in 10 dB steps, with an accurac of ± 0.1 dB per step and ± 0.5 dB overall. I.F. Fine Attenuator 0 to 10 dB, in 2 dB steps, with an accuracy of ± 0.1 dB per step. When using input voltages of between 5 and 15 millivolts open circuit, at frequencies above 120 Mc/s an additional error of 0.3 dB may occur up to 200 Mc/s and 1.5 dB above 200 Mc/s.

H.F. Attenuators

Two 75 ohm external pads of 20 dB each are provided, allowing a total attenuation of 40 dB, with an accuracy for each pad of ± 0.3 dB up to 120 Mc/s increasing to ± 1.5dB at 300 Mc/s.

Bandwidths:

Three alternative bandwidths are provided. The nominal I.F. pass-bands, for 3 dB down, are:-
15 to 35 kc/s (20 kc/s bandwidth)
15 to 85 kc/s (70 kc/s bandwidth)
15 to 515 kc/s (500 kc/s bandwidth)
On the 20, 70 and 500 kc/s bandwidths positions the I.F. sensitivity is approximately 50 dB down at I.F. frequencies of 80, 170 and 1500 kc/s respectively.

Harmonic Generation:

It is possible to measure second harmonic components up to 55 dB down on the fundamental and higher harmonics up to 70 dB down, provided the level of the fundamental signal does not exceed the specified maximum input.

Set Gain:

A SET GAIN control provides a continuous control of gain over a range of approximately 3 dB.

Output Indication:

Output indication is provided by a meter which is calibrated from - 2 dB to + 2 dB, thus interpolating the 2 dB steps of the I.F. fine attenuator.
No 'Set Zero' control is necessary.
The meter is average reading and the indicated level is relatively independent of any symmetrical amplitude modulation on the signal being measured. An overload circuit protects the meter from damage due to excessive input signals.

Modulation Monitoring:

Alternative amplitude or frequency demodulation of the I.F. signal is available, and a telephone jack for connection of high impedance headphones is provided.

I.F. Output:	An I.F. output socket is provided on the front panel for external monitoring purposes. The I.F. output level, with the meter at 0 dB is approximately 0.25V r.m.s. from impedance of 1200 ohms.
Valves:	The valves used in the instrument are:- 5Z4, 150C2, EC91, 5718, EF86, 12AT7, EF91 (3 off), 6U8 (2 off)
Power Supplies:	The instrument operates from 50 to 60 c/s mains supply. A mains adjustment panel is provided with taps covering the ranges:- 105 to 115 volts, 120 to 130 volts, 200 to 215 volts, 216 to 234 volts, and 235 to 255 volts.
Power Consumption:	The power consumption is approximately 85 watts.
Dimensions:	19" wide x 16" high x 10" deep (48 x 40 x 25.5 cms). The instrument is suitable for use on a bench or forward mounting on a standard 19" rack.
Finish:	The case and front panel have an oyster grey hammer finish.
Weight:	Approximately 60 lbs (27 kg).

3. DESCRIPTION

3.1 General

The circuit diagram of the Wave Analyser Type 248 is given in Figure 1 and the Schedule of Components in Table 1.

The outline drawing (Figure 2) illustrates the position of the major components.

The various parts of the circuit are described below.

3.2 Power Supplies

The Power pack forms a separate sub-unit within the instrument. H.T. supply is provided by the rectifier, V1, followed by normal smoothing circuits.

A stabilised h.t. supply of 150 volts is provided in the main unit by the voltage stabiliser, V2.

3.3 H.F. Circuits

The signals to be measured are applied to V3, a grounded grid amplifier, via the INPUT socket SKT1 and a high-pass filter, C11, L6 and C10. This filter attenuates signals at frequencies below the range of the Analyser. The local oscillator stage, V4, incorporates a Colpitts type circuit having a frequency coverage of 5 Mc/s to 300 Mc/s in six ranges. These ranges are selected by a turret which brings into circuit one of the inductors L6 to L13, and its associated trimming capacitors. The frequency is varied over each range by the two-gang capacitor, C14a and C14b, which is connected via a slow motion drive and film scale unit to the main tuning control.

The oscillator tuned circuit is common to V3 anode circuit and hence both signal and local oscillator frequencies are present. Mixing occurs at the oscillator grid. The i.f. signals are taken via R9, L17 and L18 to the i.f. amplifier, these components forming the series arm of a low-pass filter which removes unwanted h.f. components from the i.f. output. The shunt arms of the filter are provided by stray circuit capacitances.

3.4 Two Stage I.F. Amplifier

The i.f. signals are first applied to the control grid of V5. Valves V5 and V6 form a conventional untuned amplifier with negative feedback taken from the screen grid of V6a back to the cathode of V5. The signal at the anode of V6a is passed via the I.F. BANDWIDTH switch, SW3, to one of three low-pass filters having nominal cut-off frequencies of 35 kc/s, 85 kc/s and 515 kc/s respectively.

The output from the filters passes from R25, a preset i.f. gain control, to V6b, a cathode follower stage, and the output from V6b is fed via a series of variable resistors, to the i.f. attenuators. These variable resistors are selected by a wafer switch, SW4, ganged to the turret control and are used to equalise the overall gain of the instrument on each of the turret ranges. On the 160 Mc/s to 300 Mc/s range, the output from V6b is taken directly to the attenuators.

3.5 I.F. Attenuators

Two ladder type attenuators are provided, one giving a total of 60 dB attenuation in steps of 10 dB, and the other 10 dB total attenuation in 2 dB steps.

The 2 dB step attenuator forms the final shunt arm of the 10 dB step attenuator. The attenuated output is taken from the last step on the 2 dB attenuator and is applied to the control grid of V7.

3.6 Three Stage I.F. Amplifier and Meter Circuits

Valves V7, V8 and V9 form a conventional untuned amplifier with negative feedback applied between the cathodes of V9 and V7. The feedback is variable by means of the SET GAIN control, R70. Valve V9 feeds into a high-pass filter, L24, C66 and L25 which limits the low frequency response and reduces metering errors due to him and noise. It also determines the width of the 'trough' obtained when tuning the instrument.

The i.f. signal is applied, via R81, to meter rectifiers MR1 and MR2, the meter being average rather than peak reading.

Capacitors C68, C69 prevent any radiation of i.f. signals from the meter and its associated wiring which might cause instability.

Rectifier MR1 conducts when MR2 is cut off and thus maintains the correct filter termination.

The meter is protected against overload by an AGC voltage applied to the suppressor grid of V9. Under overload conditions V9 suppressor grid is biased negatively causing the gain of the stage to be reduced.

3.7 I.F. Output, Meter Protection and F.M. Limiting

The i.f. signal is taken via C70 to the control grid of V10a. Valve 10a acts as a buffer stage and provides three outputs:-

(a) from the cathode, via C74 and R91, to the I.F. OUTPUT socket SKT3, and also via C75 to the grid of V10b.

(b) from the anode, via C72 to rectifier MR3, to provide the AGC voltage for meter protection. Rectifier MR3 is returned to V10b cathode, the cathode bias of this stage providing a suitable delay voltage.

(c) from the junction of R87 and R88 via C76 to the a.m. detector circuit.

Valve V10b is an amplifier stage the anode circuit of which is connected to diodes MR4, MR5, these providing amplitude limiting prior to f.m. detection.

3.8 Detector and I.F. Amplifier

The f.m. detection is carried out by C80, MR6, MR7 and R98, a form of pulse counting circuit in which a voltage proportional to frequency is developed across R98.

The a.m. detection is achieved by MR6 acting as a normal shunt detector.

Unwanted i.f. ripple is removed by R100, C82, R101 and C83.

V11 is a two-stage audio frequency amplifier the input to which is controlled by the VOLUME control R104. The output from the anode of V11b is applied via C89, to a telephone jack JK1 (PHONES).

4. INITIAL ADJUSTMENT

The instrument is despatched from the Works with the voltage tapping panel set for a mains supply of between 216 and 234 volts. If the instrument is to be used on mains supplies outside these voltage limits, it must be removed from its case and the plug on the tapping panel moved to the nearest appropriate mains tap.

The tappings available are for the voltage ranges of 105 to 115, 120 to 130, 200 to 215, 216 to 234 and 235 to 255. If the instrument is to be used on one of the two low voltage ranges a fuse of double the current rating of that given in the Schedule of Components in Table 1, must be fitted.

Apart from this the instrument leaves the Works ready for use and only requires to be connected to the mains supply by means of the 3-core lead provided, in which the RED and BLACK cores are LINE and NEUTRAL respectively, and the third core EARTH.

5. OPERATION

5.1. General

Before switching ON the instrument, check the mechanical zero of the meter and, if necessary, set the needle position by means of the adjusting screw.

After making the initial adjustments stated in Section 4 above, the instrument may be switched ON and should be allowed to warm up for a period of at least five minutes before any measurements are taken.

The various uses of the instrument are detailed in subsequent sections but the following general points should be noted.

(a) Tuning When level measurements are taken it will be noted that rocking the tuning control gives two maxima on the meter, corresponding to an i.f. within the pass band of the amplifiers, on either side of zero beat. The two peaks are normally of equal amplitude but under certain circumstances slight variations can occur and therefore, when the most accurate results are required, the response obtained with the tuning knob counter-clockwise from zero beat should be used.

(b) Attenuators In addition to the i.f. attenuators, external h.f. attenuator pads are provided. The pads should be plugged directly into the INPUT socket on the front panel. In determining the relative amounts of each type of attenuator to be inserted it should be remembered that the effect of noise is reduced by employing the i.f. attenuator but that harmonic generation will in general be greater owing to the larger signal appearing at the h.f. amplifier valve. It should also be noted that some oscillator pulling occurs at inputs of above 5 millivolts at frequencies above 120 Mc/s. In order to reduce errors from this cause to a minimum, the 500 kc/s bandwidth should be used when measurements in this region are required.

If the greatest accuracy of level measurement is required when the external 20 dB attenuators are in use, their precise attenuation can be determined at a particular signal frequency by checking them against the internal i.f. attenuators and calibrated meter scale.

(c) Signal Level Calibration The basic sensitivity of the instrument on all frequency ranges is arranged such that with the i.f. attenuators both set to 0 dB, the SET GAIN control fully clockwise, and with no h.f. attenuator pads in use, an input signal of 5 microvolts applied via a 75 ohms impedance at the INPUT socket will result in a peak meter deflection to the 0 dB mark on the scale. The attenuator readings and meter indication thus effectively give the level of an input signal in terms of "dB above 5 microvolts open circuit from a 75 ohm source". For example, with the COARSE I.F. attenuator at 50 dB, the FINE I.F. attenuator at 8 dB and a peak meter deflection of -1 dB, the open circuit input level is 57 dB above 5 microvolts (3.54 millivolts).

The actual sensitivity of the instrument at any frequency is normally within ± 1.5 dB of the basic average sensitivity defined above.

Due to the errors caused by noise when working at maximum sensitivity, and to the difficulty of generating 5 microvolt signal levels with the required accuracy, the sensitivity of the instrument is set at the Works using a much higher input level and appropriate internal attenuation.

(d) Input Impedance At low frequencies the input impedance is 75 ohms but at higher frequencies some variation occurs due to the input (H.F. Amplifier) stage.

It should be noted however, that when the instrument is connected to a 75 ohm source, no measurement errors are caused by changes in input impedance. In those cases where a constant 75 ohms input impedance is desired it is recommended that one or both of the external h.f. attenuators be used whenever practicable, plugged into the INPUT socket on the panel.

(e) I.F. Bandwidths Three i.f. bandwidths are provided, as given in the Specification Section 2. The overall bandwidth of the instrument is affected by the h.f. circuits and therefore at lower frequencies the widest i.f. bandwidth (500 kc/s) cannot be realised.

The bandwidth selected may be chosen for reasonable ease of tuning, but it should be noted that the noise level increases with increased bandwidth so that to minimise errors due to noise when working with low i.f. attenuation, it is advisable to use the narrowest bandwidth position.

(f) Local Oscillator Due to feedback through the input H.F. Amplifier, 60 millivolts approximately of oscillator voltage is developed at the INPUT terminal. This will not normally prejudice the accuracy of measurement. If the signal source connected to the Wave Analyser INPUT is fitted with an output level meter, the reading on this meter may be affected by the local oscillator signal.

5.2 Operation as a Harmonic Analyser

Due to harmonic generation within the instrument, it is preferable to keep the level of the fundamental as low as is convenient when measuring harmonic components. It is important, also, that the fundamental input level does not exceed 15 millivolts open circuit from a 75 ohm source, at the INPUT plug.

The procedure for harmonic analysis is as follows:-

(a) Tune the Wave Analyser to the fundamental signal using a suitable bandwidth.

(b) Adjust the I.F. ATTENUATORS and the SET GAIN control to bring the meter to its OdB mark. Note the sum of the attenuator settings (say S_f).

(c) Wihtout altering the SET GAIN control, tune the Wave Analyser to the desired harmonic and reduce the i.f. attenuation to bring the meter within its $\pm$ 2 dB calibration. Note the sum of the attenuator settings and add the meter reading algebraically, that is, taking account of its sign. Let the resulting figure be S_h.

(d) The strength of the desired harmonic in dB relative to the fundamental is the difference in the total i.f. attenuation in (b) and (c) above, that is, $S_h - S_f$. This will be negative for the normal case where the harmonic is at a lower level than the fundamental.

(e) Where the highest order of accuracy of level difference is required and a signal generator with an accurately known output level is available, the relative sensitivities of the Wave Analyser Type 248 may, of course, be measured at the frequencies of interest and suitable corrections applied to the attenuation readings.

5.3 Operation for Selective Level Measurements

The instrument may be used for measuring the absolute level of any single frequency component of a complex waveform. The discrimination against unwanted signals is governed principally by the response of the three alternative i.f. amplifier filters together with that of the h.f. tuned circuit.

It should be noted that difficulty may be encountered in measuring a signal at a particular frequency in the presence of signals of equivalent or higher levels at frequencies which are at or very near to multiple values of the frequency concerned, for example, in measurement of sub-harmonic content. In these cases a spurious i.f. can be produced within the i.f. pass-band due to the unwanted signal mixing with the harmonics of the local oscillator.

In these circumstances it is often advantageous to tune, not for maximum meter response, but to the point where the response is precisely 3 bD down on the peak value. The 3 dB point selected should be the one remote from the sharp centre null, that is, the one occurring at an i.f. of approximately 35, 85 or 515 kc/s depending on the bandwidth setting. The absolute input signal level in this case will be 3 dB higher than that indicated by the attenuator and meter settings.

5.4 Operation as a Field Strength and Interference Measuring Set

Field strength and interference measurements may be made using suitable aerials in conjunction with the Wave Analyser Type 248.

The sensitivity is such that signals of 5 microvolts open circuit from a 75 ohm source between frequencies of 5 and 300 Mc/s can be measured and the variable bandwidths used to reduce interference from other signals.

To assist the identification of modulated signals, high impedance headphones can be inserted in the PHONES jack. The monitoring switch is used to select a.m. or f.m. demodulation and the audio output level is controlled by the VOLUME control.

5.5 Operation for Insertion Gain and Loss Measurements

Insertion gain and loss measurements may be made at any frequency between 5 and 300 Mc/s over a range of 70 dB, by substitution of the I.F. ATTENUATORS.

When using the Wave Analyser Type 248 at its highest sensitivity, it should be remembered that errors are introduced due to noise. Provided adequate input signal level is available the range can be extended by a further 40 dB by use of the external H.F. ATTENUATORS, and the accuracy maintained by checking the H.F. ATTENUATORS against the I.F. ATTENUATORS.

5.6 Operation as a Bridge Detector

The instrument may be used as a high sensitivity bridge detector when tuned to the frequency of operation of the bridge. If the signal is modulated, headphones may be used in addition to the meter. Excessive signals due to bridge unbalance cannot damage the meter.

5.7 Operation as a Heterodyne Wavemeter

The Wave Analyser Type 248 may be used as a Wavemeter. The dip in the meter reading, occurring at zero beat, is used to locate the exact frequency which can then be read direct from the film scale.

6. RACK MOUNTING

The instrument is designed so that it may be forward mounted on a standard 19" rack, if required.

The unit should be removed from its case and the case fixed to the rack by means of O BA screws through the slotted holes provided for this purpose. The unit should then be replaced in its case.

The instrument, including the feet, is intended to occupy the same rack space as that of a 15¾" panel.

7. SERVICING

7.1 General

Valves, scale lamp and fuse replacements are the only servicing changes which should normally be required. The respective position of these components is shown in Figure 2.

The preset controls and their function are listed in Table 2.

7.2 Valve Replacements

Certain valve replacements may require slight adjustments within the instrument. The frequency calibration may be affected by the oscillator valve V4 and the absolute gain of the instrument by the i.f. amplifier valves V5 and V6 and the h.f. amplifier V3.

Readjustment is dealt with in the following sections.

7.3 Readjustment of Oscillator

Before replacing the oscillator valve, a careful note of the wiring should be made and copied exactly when wiring in the new valve. Slight adjustments to the oscillator coils and trimmer capacitors are all that should be necessary. The coil tuning slugs should be adjusted using a non-metallic tuning tool through the hole provided in the rear of the turret assembly. A non-hardening compound has been used for locking these cores. The trimming capacitors should be adjusted using an insulated tool through the two holes provided in the top of the turret assembly.

The inductors should be adjusted at the low frequency end of the range and the trimming capacitors at the high frequency end. The two trimming capacitors provided on each range are normally set approximately equal, but the sensitivity variation over each band may be controlled to some extent if required, by setting these capacitors unequally.

7.4 I.F. Gain

The gain of the i.f. amplifier is controlled by R25, and this is normally adjusted on the 160 to 300 Mc/s range such that an input of 1.58 millivolts open circuit from a 75 ohm source brings the meter to the 0 dB mark when the i.f. coarse and fine attenuators are set to 40 and 10 dB respectively and the SET GAIN control is fully clockwise.

The preset controls R31 to R35 may then be used to adjust the gain on the remaining turret ranges.

7.5 Film Scale and Slow Motion Drive

The design of the Film Scale and the Slow Motion Drive involves the use of gears and bearings and in common with such mechanisms periodical lubrication is required. One or two drops of thin lubricating oil should be given to each of the bearings and gears in the slow motion drive and the film scale unit. Access to the latter is obtained by first removing the tuning knob and then the front escutcheon by means of the four round headed screws around its outer edge. When re-assembling the tuning knob on its spindle, care should be taken to ensure that the reading on its scale is exactly '0' when the knob is rotated anticlockwise against the mechanical stop, which should also correspond to a reading of '0' on the logging scale of the film scale.

7.6 Scale Lamp Replacement

The tuning scale is illuminated by two festoon lamps located behind the translucent scale. Access to the lamps for replacement purposes, is obtained by removing the tuning knob and front escutcheon as described in Section 7.5 above. It will then be necessary to lift up the film scale gently for a distance of a few inches to replace the lamps.

TABLE 1

WAVE ANALYSER TYPE 248

SCHEDULE OF COMPONENTS

Circuit Reference	Description	Type	Tol ± %	Rating
Resistors				Watts
R1	0.8 ohms Resistor Assembly	6318-184		Airmec Ltd
R2	4.7 kohms Wirewound	AW3112	5	10
R3	6.8 kohms	RMA8	10	½
R4	100 ohms	A3611	5	½
R5	47 ohms adjust on test	A3611	5	½
R6,R7	330 ohms	7AD	10	½
R8	470 ohms	7AD	10	½
R9	4.7 kohms	7AD	10	½
R10	10 kohms	7AD	10	½
R11	6.8 kohms	RMA8	10	½
R12	1 kohms Wirewound	AW3112	5	10
R13	47 kohms	7AD	10	½
R14	6.8 kohms	RMA8	10	½
R15	10 kohms	RMA8	10	½
R16	220 ohms	7AD	10	½
R17	68 ohms	A2611	5	½
R18	100 kohms	7AD	10	½
R19	Resistor Assembly	6415-272	Airmec Ltd	
R20	1 kohms	7AD	10	½
R21	4.7 kohms	RMA8	10	½
R22	22 kohms	RMA8	10	½
R23	220 ohms	7AD	10	½
R24	4.7 kohms	108	5	½
R25	4.7 kohms W.W.,var.,linear	1106/9s	10	1
R26	100 kohms	7AD	10	½
R27	1 kohms	7AD	10	½
R28	1 kohms	RMA8	10	½
R29	330 ohms	7AD	10	½
R30	1 kohms	RMA8	10	½
R31,32,33	2.5 kohms W.W, variable, linear, preset	P22	10	3
R34,35	1 kohms W.W, variable linear, preset	P22	10	3
R36 to R41	855.6 ohms	6415-225	Airmec Ltd	
R42	394.9 ohms	6415-226	Airmec Ltd	
R43 to R47	577.6 ohms	6415-227	Airmec Ltd	
R48 to R52	183.4 ohms	SA3601	1	⅛
R53	709 ohms	SA3601	1	⅛

TABLE 1 (continued)

WAVE ANALYSER TYPE 248

SCHEDULE OF COMPONENTS

Circuit Reference	Description	Type	Tol ± %	Rating
Resistors				Watts
R54 to R57	3444 ohms	SA3601	1	1/8
R58	709 ohms	SA3601	1	1/8
R59	1 kohms	7AD	10	1/2
R60	2.2 kohms	RMA8	10	1/2
R61	10 kohms	RMA8	10	1/2
R62	Not used			
R63	330 ohms	7AD	10	1/2
R64	22 ohms	A3611	5	1/2
R65	1 kohms	7AD	10	1/2
R66	100 kohms	7AD	10	1/2
R67	2.2 kohms	RMA8	10	1/2
R68	10 kohms	RMA8	10	1/2
R69	1.5 kohms	A3611	5	1/2
R70	1 kohms w.w, variable, linear	CLR 4039/13	10	3
R71	330 ohms	7AD	10	1/2
R72	100 kohms	7AD	10	1/2
R73	1 kohms	7AD	10	1/2
R74	220 kohms	7AD	10	1/2
R75	10 kohms	RMA8	10	1/2
R76	3.9 kohms	A3611	5	1/2
R77	220 ohms	7AD	10	1/2
R78	22 ohms	A3611	5	1/2
R79	Not used			
R80	4.7 kohms wirewound	AW3112	5	10
R81	3.9 kohms	A3611	5	1/2
R82	1 Mohms	7AD	10	1/2
R83	470 kohms	7AD	10	1/2
R84	100 kohms	7AD	10	1/2
R85	1 kohms	7AD	10	1/2
R86	2.2 kohms	RMA8	10	1/2
R87	680 ohms	7AD	10	1/2
R88	6.8 kohms	RMA8	10	1/2
R89	470 ohms	7AD	10	1/2
R90	47 kohms	7AD	10	1/2
R91	1 kohms	7AD	10	1/2
R92	470 kohms	7AD	10	1/2
R93	1 kohms	7AD	10	1/2

TABLE 1 (continued)

WAVE ANALYSER TYPE 248

SCHEDULE OF COMPONENTS

Circuit Reference		Description	Type	Tol ± %	Rating
Resistors					**Watts**
R94	10	kohms	RMA8	10	½
R95	330	ohms	7AD	10	¼
R96	100	kohms	RMA8	10	½
R97	2.2	kohms	RMA8	10	½
R98	4.7	kohms	7AD	10	¼
R99		Not used			
R100,101	47	kohms	7AD	10	¼
R102	330	kohms	7AD	10	¼
R103	150	kohms	7AD	10	¼
R104	1	Mohms, carbon, variable, log law	LH	20	⅛
R105	100	kohms	7AD	10	¼
R106	2.2	kohms	7AD	10	¼
R107	470	kohms	7AD	10	¼
R108	100	kohms	7AD	10	¼
R109	33	kohms	RMA8	10	½
R110	1	kohms	7AD	10	¼
R111		Not used			
R112	371	ohms	C21	1	¼
R112,R114	92	ohms	C21	1	¼
Capacitors					**Volts**
C1	32+32	uF	C18P	-20+50	450
C2,3,4	1000	pF	K1200/51	20	350
C5,6	0.01	uF	W48	25	350
C7,8	1500	pF	K1500BD	20	500
C9	1000	pF	K1200/51	20	350
C10,11	1500	pF	K1200BD	20	500
C12	1	uF	W48	25	150
C13	1500	pF	K1200BD	20	500
C14	73.7+73.7	pF Capacitor Assembly	6415-186	Airmec Ltd	
C15 to C20	1.25-10	pF trimmer	C32-01	Wingrove & Rogers	
C21	10	pF	NP0-K	10	750
C22 to C27	1.25-10	pF	C32-01	Wingrove & Rogers	
C28,29	1000	pF	K1200/51	20	350
C30	500	pF	K1200	20	500

TABLE 1 (continued)

WAVE ANALYSER TYPE 248

SCHEDULE OF COMPONENTS

Circuit Reference	Description	Type	Tol ± %	Rating
Capacitors				Volts
C31	47 pF	K1200	20	500
C32	1500 pF	K1200BD	20	500
C33,34	1000 pF	K1200/51	20	350
C35a,C35b	16+16 uF	L35/4	-20+50	350
C36	1500 pF	K1200BD	20	500
C37	1 uF	W48	25	250
C38	0.25 uF	W48	25	150
C39	Not used			
C40	1500 pF	K1200BD	20	500
C41,42	0.1 uF	W48	25	250
C43	0.25 uF	W48	25	150
C44,46	1050 pF	Polystyrene	2	350
C45	2100 pF	Polystyrene	2	350
C47,49	440 pF	Polystyrene	2	350
C48	890 pF	Polystyrene	2	350
C50,51	75 pF	Polystyrene	2	350
C52	1500 pF	K1200BD	20	500
C53,54	1 uF	W48	25	150
C55	0.1 uF	W48	25	250
C56	0.25 uF	W48	25	150
C57	0.002 uF	Metalmite	25	500
C58	1500 pF	K1200BD	20	500
C59	Not used			
C60	0.1 uF	W48	25	250
C61	0.25 uF	W48	25	150
C62	1500 pF	K1200BD	20	500
C63,64	0.1 uF	W48	25	250
C65	0.25 uF	W48	25	150
C66	1660 pF	Polystyrene	2	250
C67,68	0.1 uF	W48	25	150
C69	0.01 uF	L51	25	500
C70	1500 pF	K1200BD	20	500
C71	0.1 uF	W48	25	250
C72	1500 pF	K1200BD	20	500
C73	0.1 uF	W48	25	250
C74	0.1 uF	W48	25	150
C75	1500 pF	K1200BD	20	500

TABLE 1 (continued)

WAVE ANALYSER TYPE 248

SCHEDULE OF COMPONENTS

Circuit Reference	Description	Type	Tol. ± %	Rating
Capacitors				Volts
C76	0.1 uF	W48	25	250
C77	0.1 uF	W48	25	150
C78	0.1 uF	W48	25	250
C79	Not used			
C80	47 pF	111M	20	750
C81	0.1 uF	W48	25	150
C82,83	470 pF	K1200BD	20	500
C84,85	1500 pF	K1200BD	20	500
C86	470 pF	K1200AD	20	500
C87	100 uF	CE59AE	-20+50	6
C88	0.005 uF	Metalmite	25	350
C89	0.1 uF	W48	25	250
C90	0.1 uF	W48	25	350
Inductors and Transformers				
L1	Choke Assembly 5 H	212-0303		Airmec Ltd.
L2,L5	Choke Assembly 10 uH	6045-234		Airmec Ltd.
L3,L4	Coil Assembly 1 uH	6045-235		Airmec Ltd.
L6	Coil Assembly 4 uH	6415-184		Airmec Ltd.
L7	Inductor Assembly 50 uH	6415-111		Airmec Ltd.
L8	Turret Coil Assembly	6415-192		Airmec Ltd.
L9	Turret Coil Assembly	6415-193		Airmec Ltd.
L10	Turret Coil Assembly	6415-194		Airmec Ltd.
L11	Turret Coil Assembly	6415-195		Airmec Ltd.
L12	Turret Coil Assembly	6415-196		Airmec Ltd.
L13	Turret Coil Assembly	6415-197		Airmec Ltd.
L14	Not used			
L15,16	Heater Choke Assembly	6369-275		Airmec Ltd.
L17	Inductor Assembly 350 uH	6415-254		Airmec Ltd.
L18	Inductor Assembly 0.8 uH	6415-253		Airmec Ltd.
L19	Inductor Assembly 33.5 mH	6415-129		Airmec Ltd.
L20	Inductor Assembly 33.5 mH	6415-130		Airmec Ltd.
L21	Inductor Assembly 14.3 mH	6415-131		Airmec Ltd.
L22	Inductor Assembly 14.3 mH	6415-132		Airmec Ltd.
L23	Inductor Assembly 2.33 mH	6415-133		Airmec Ltd.
L24,25	Inductor Assembly 29.86 mH	6415-128/9		Airmec Ltd.
T1	Transformer Assembly	212-0506		Airmec Ltd.

TABLE 1 (concluded)

WAVE ANALYSER TYPE 248

SCHEDULE OF COMPONENTS

Circuit Reference	Description	Type	Maker
Valves			
V1	5Z4 Brimar V2	150C2	Mullard
V3	EC91 Mullard V4	5718	Mullard
V5	EF86 Mullard V6,V10	6U8	Mullard
V7,8,9	EF91 Mullard V11	12AT7	Brimar
Rectifiers			
MR1 to MR3	Germanium Diode	CG1E	A.E.I.
MR4 to MR7	Germanium Diode	GD.3	Brimar
Switches			
SW1	Cutler hammer, dp co. 250V 3A ON/OFF 8370-K7		N.S.F.
SW2	Turret Switch Assembly	6415-160	Airmec Ltd
SW3	Wafer 2 pole, 3 way	6415-134	Airmec Ltd
SW4	Wafer 2 pole, 6 way	6415-216	Airmec Ltd
SW5	Wafer 2 pole, 7 way	6415-125	Airmec Ltd
SW6	Wafer 1 pole, 6 way	6415-122	Airmec Ltd
SW7	Wafer 2 pole, 2 way	6415-215	Airmec Ltd
Plugs and Sockets			
JK1	Jack Telephone	J12	Bulgin
PL1	Plug Mains, 3 pin, 250V,3A	SA1861	Bulgin
PL2	Plug coaxial free	L734/P	Belling Lee
SKT1	Bulkhead Adaptor	L517	Belling Lee
SKT2	Socket Coaxial fixed	L604/S	Belling Lee
SKT3	Socket coaxial fixed	L603	Belling Lee
Miscellaneous			
F1	Fuse standard cartridge 2A	1055/2A	Belling Lee
LP1,LP2	Lamp 6V, 3W, m.e.s.	255	Osram
M1	Meter 50 uA f.s.d. (scale to 6415-144)	Mod.250	Taylor Instr.
	R.F. Input Attenuator 2 off	6415-260	Airmec Ltd

TABLE 2

WAVE ANALYSER TYPE 248

FUNCTIONS OF PRESET CONTROLS

Circuit Reference	Function	Range (Mc/s)
L8, C15, C22	Oscillator Frequency Adjustment	5 to 10
L9, C16, C23	" " "	10 to 20
L10, C17, C24	" " "	20 to 40
L11, C18, C25	" " "	40 to 80
L12, C19, C26	" " "	80 to 160
L13, C20, C27	" " "	160 to 300
R25	I.F. GAIN control Adjustment	Common to all Turret Ranges
R31	" " "	5 to 10
R32	" " "	10 to 20
R33	" " "	20 to 40
R34	" " "	40 to 80
R35	" " "	80 to 160

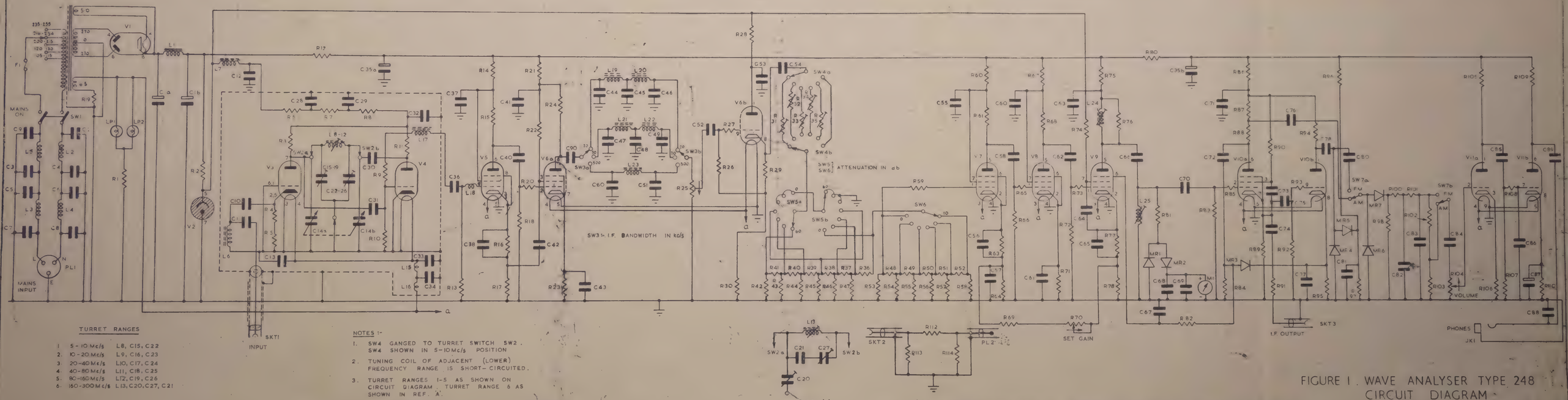

TURRET RANGES
1 5 - 10 Mc/s L8, C15, C22
2. 10 - 20 Mc/s L9, C16, C23
3. 20 - 40 Mc/s L10, C17, C24
4. 40 - 80 Mc/s L11, C18, C25
5. 80 - 160 Mc/s L12, C19, C26
6. 160 - 300 Mc/s L13, C20, C27, C21
NOTES :-
1. SW4 GANGED TO TURRET SWITCH SW2. SW4 SHOWN IN 5 - 10 Mc/s POSITION
2. TUNING COIL OF ADJACENT (LOWER) FREQUENCY RANGE IS SHORT - CIRCUITED.
3. TURRET RANGES 1-5 AS SHOWN ON CIRCUIT DIAGRAM. TURRET RANGE 6 AS SHOWN IN REF. 'A'.
4. ALL SWITCHES SHOWN FULLY ANTI-CLOCKWISE.
MAINS ON
MAINS INPUT
INPUT
SKT1
SW3 I.F. BANDWIDTH IN kc/s
ATTENUATION IN db
SET GAIN
I.F. OUTPUT
SKT3
VOLUME
PHONES
JK1
REF 'A'
20 db R.F. ATTENUATOR

FIGURE 1. WAVE ANALYSER TYPE 248 CIRCUIT DIAGRAM

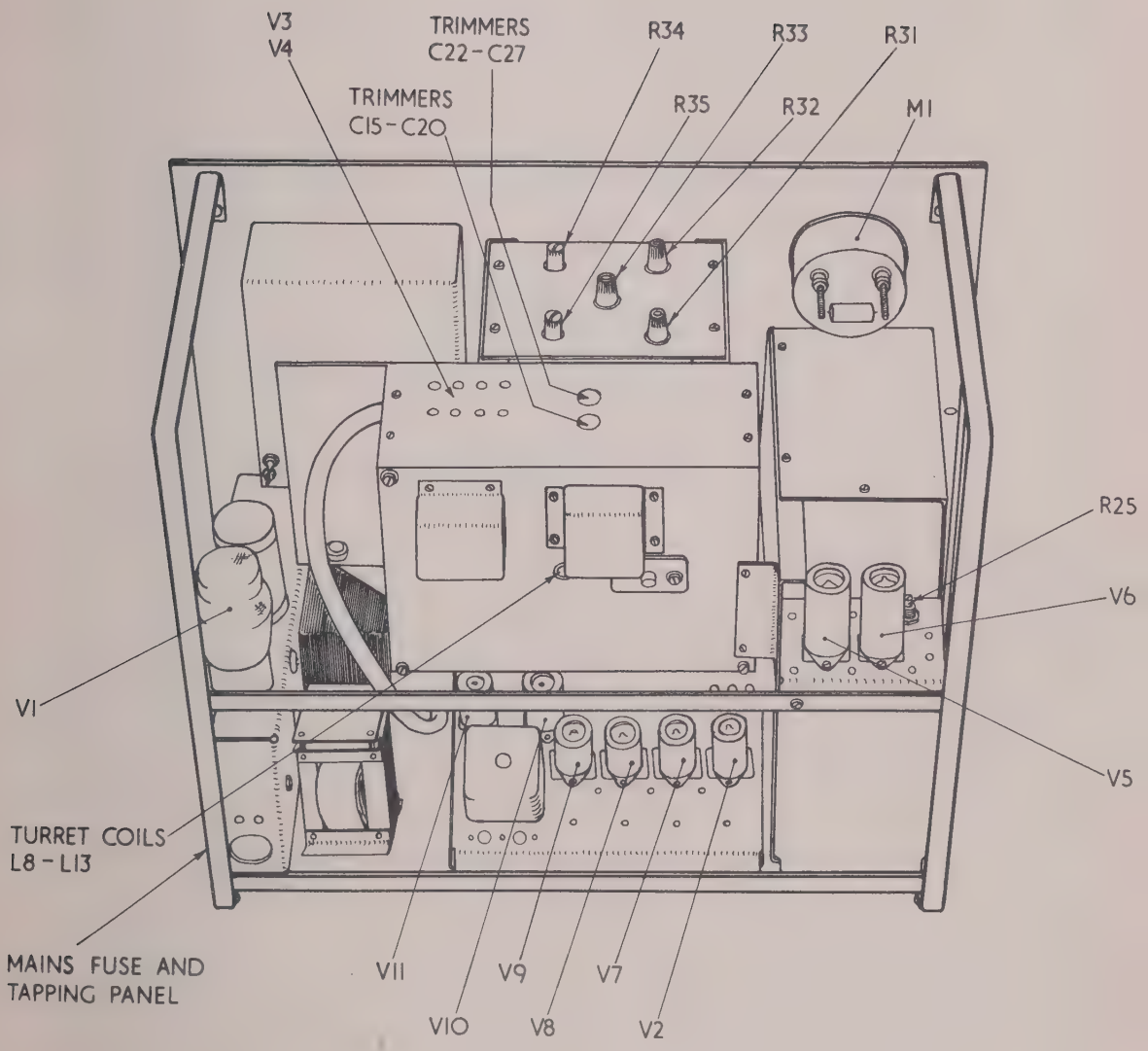


FIGURE 2 WAVE ANALYSER TYPE 248

INTERNAL VIEW

GENERAL LIABILITY AND MAINTENANCE GUARANTEE

In lieu of any warranty, condition or liability implied by law, our liability in respect of any defect in or failure of the goods supplied, or for loss, injury, or damage attributable thereto, is limited to making good by replacement or repair defects which, under proper use by the original purchaser, appear therein and arise solely from faulty materials or workmanship within a period of twelve calendar months after the original goods shall have been first despatched, at the termination of which period all liability on our part ceases; provided always that such defective instruments are carefully packed and returned free to our Works unless otherwise arranged, and provided they have not been tampered with in any way. The repaired instrument will be delivered free to its destination in Great Britain, or f.o.b. British Port, for overseas shipments. Reasonable charges will be made for attendance of Personnel at Customers' premises and for any dismantling should this be necessary in order to effect the required replacements.

For components not of our manufacture we extend only such benefits as we may receive under any guarantee given to us by the makers thereof. Electronic valves and cathode ray tubes manufactured by members of the British Radio Valves Manufacturers' Association are marked with the letters B.V.A. which is guarantee of efficiency and quality. Our equipment has been designed and tested for use with the specific types of components supplied by us therein and no responsibility can be accepted for the performance of the equipment if other components are employed.

AIRMEC LIMITED,
HIGH WYCOMBE,
BUCKINGHAMSHIRE,
ENGLAND.

Printed in England

MP MASTER
MA34333